Acute Complications in Total Wrist Arthroplasty: A National Surgical Quality Improvement Program Review

Michael D. Eckhoff, MD[1] Julia M. Bader, PhD[2] Leon J. Nesti, MD, PhD[3] John C. Dunn, MD[1]

[1] Department of Orthopaedics, William Beaumont Army Medical Center, El Paso, Texas
[2] Department of Clinical Investigation, William Beaumont Army Medical Center, El Paso, Texas
[3] Clinical and Experimental Orthopaedics, Department of Surgery, Uniformed Services University of the Health Sciences, Bethesda, Maryland

Address for correspondence Michael D. Eckhoff, MD, Department of Orthopaedic Surgery, William Beaumont Army Medical Center, 5005 North Piedras Street, El Paso, TX 79920 (e-mail: michael.d.eckhoff2.mil@mail.mil).

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Abstract

Background The study sought to assess the patient-based variables, surgical risk factors, and postoperative conditions associated with readmission after total wrist arthroplasty (TWA).

Materials and Methods All patients undergoing TWA were identified from the National Surgical Quality Improvement Program dataset from 2005 to 2016. Patient demographics, medical comorbidities, surgical characteristics, and outcomes were examined to isolate predictors for readmission within 30 days postoperatively.

Results A total of 57 patients were identified to have undergone TWA. The average patients were 62.3 (13.8) years old, female (57.7%), and most were treated in the outpatient setting (67.3%). Comorbid conditions included smoking (17.3%), diabetes (15.4%), and chronic steroid therapy (15.4%). No complications were identified in the 30-day postoperative period. There was a trend for increasing utilization of TWA over the years included.

Conclusion TWA is a safe procedure with low complication rates in the acute postoperative period. Increasing utilization is likely a result of improved outcomes and cost-effectiveness of TWA.

Level of Evidence This is a Level II, prognostic study.

Keywords
- arthroplasty
- arthrodesis
- osteoarthritis
- wrist
- NSQIP

Total wrist arthroplasty (TWA) is a successful[1] and cost effective[2] treatment for end stage wrist arthritis which has demonstrated improved design with each successive generation of implant.[3] Arthroplasty is specifically indicated for inflammatory arthritis, posttraumatic arthritis, and osteoarthritis.[2,4–6] Traditionally these conditions were treated with arthrodesis,[7] however, arthroplasty both alleviates a painful deformity while retaining motion through the radiocarpal joint.

Initial TWA designs were plagued by complications, low survivorship, and consisted of a single silicone elastomer.[3,8,9] However, the latest fourth generation designs have made significant advancements and include articulating radial and carpal components of polyethylene and porous-coated metals. Fourth generation designs have demonstrated improved pain,[10,11] range of motion,[10] function,[6] and improved survivorship; 95% at 8 years[11] and 77% at 15 years.[8]

While reported complications of TWA include infection, contracture, component loosening, and dislocation,[2,3,5,12] the incidence of complications has varied widely (9–77%).[1,10,12,13] The purpose of this study was to correlate the short-term outcomes, complications, postoperative readmission rates for TWA with patient-specific factors through a large national dataset analysis.

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Methods

After Institutional Review Board approval, the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) database was queried. The NSQIP is a data repository that receives records from 692 participation medical centers across several health care settings in the United States. Patients enrolled in the NSQIP are prospectively followed for 30-days postoperatively and monitored for hospital readmission, postoperative complications, and mortality. The ACS stringently maintains NSQIP, which has yielded excellent interrater reliability with a 1.6% disagreement rate for all variables.[14] The use of the NSQIP database and its methodology is well documented[15–21] and can also be referenced in the program's participant user guide.[22]

We identified the one CPT (Current Procedural Terminology) code collected by the NSQIP that was relevant to the treatment with wrist arthroplasty: "Arthroplasty with prosthetic replacement; distal radius and partial or entire carpus" (CPT 25446). All cases that matched these CPT codes in the NSQIP database during the study years were included. Patient-specific factors, to include demographic data, medical comorbidities, and selected laboratory values were recorded (►**Table 1**). In addition, surgical characteristics were also collected, including total operative time, mode of anesthesia, and postoperative blood transfusion within 72 hours of the procedure.

Systemic and local complications were classified as either major or minor, based on those categories used in previous reports.[20,21] Major systemic complications were recognized as those necessitating complex medical intervention or revision, while major local complications encompassed

Table 1 Demonstrating preoperative factors, incidence, and percentage of total or standard deviation from the mean, as described in the table

Age, y, mean ± SD	62.3 ± 13.8
50 or less, *N* (%)	8 (15.3)
51–60, *N* (%)	13 (25.0)
61–70, *N* (%)	16 (30.8)
71 or greater, *N* (%)	15 (28.9)
Out vs. inpatient	
Outpatient	35 (67.3)
Inpatient	17 (32.7)
Sex, *N* (%)	
Male	22 (42.3)
Female	30 (57.7)
Body mass index, kg/m^2 mean ± SD	28.6 ± 6.8
BMI ≤29.9, *N* (%)	29 (55.8)
≥ 30.0, *N* (%)	23 (44.2)
Functional status, *N* (%)	
Independent	50 (98.0)
Partially dependent	1 (2.0)
Totally dependent	0 (0)
ASA classification, *N* (%)	
2 or less	29 (55.8)
3 or greater	23 (44.2)
Preoperative laboratory values, mean ± SD (*N*)	
White blood cell count (×103/μL)	6.5 ± 2.1 (35)
Hematocrit (%)	40.7 ± 3.9 (35)
Platelets (×103/μL)	234.0 ± 67.9 (35)
Creatinine	0.9 ± 0.2 (35)
Serum albumin (g/dL)	4.1 ± 0.3 (11)
International normalized ratio	1.0 ± 0.1 (13)
Medical co-morbidities, *N* (%)	
Smoking (current smoker within 1 y)	9 (17.3)
Regular alcohol use	0 (0)
All diabetes (insulin/noninsulin dependent) (Y/N)	8 (15.4)
Insulin-dependent diabetes	3 (5.8)
Noninsulin-dependent diabetes	5 (9.6)
History of revascularization/ amputation for peripheral vascular disease/rest pain/ gangrene	0 (0)
Bleeding disorder	1 (1.9)
Preoperative blood transfusion of ≥1 unit of RBC within 72 h of operation	0 (0)
Preoperative open wound or wound infection	0 (0)
Steroid use for chronic condition	8 (15.4)
Chemotherapy for less than 30 d	0 (0)
Radiation therapy for less than 90 d	0 (0)
Prior operation within 30 d	0 (0)
Paralysis (paraplegia, quadriplegia, hemiplegia)	0 (0)
Operative time, min, mean ± SD	139.5 ± 47.9
≤ Mean + SD, *N* (%)	41 (78.8)
> Mean + SD, *N* (%)	11 (21.2)
Type of anesthesia, *N* (%)	
General	39 (75.0)
All others	13 (25.0)
Occurrence of blood transfusions (≥1 unit of RBCs given within 72-h postoperatively), *N* (%)	
None	52 (100)
≥ 1 unit	0 (0)
Time from operation to discharge, d, mean ± SD	0.9 ± 0.9

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; RBC, red blood cells; SD, standard deviation.

periprosthetic joint infection, peripheral nerve injury, unplanned reoperation, and implant failure. Periprosthetic joint infections included all deep wound and organ or space surgical site infections. Minor systemic complications were recognized as nonsurgical site infections to include urinary tract infection and pneumonia. Minor local complications were superficial wound infections and wound disruption. Hospital readmission within 30 days of index TSA was the primary outcome measure.

Principal patient-based predictors included medical comorbidities, wound classification (clean vs. clean contaminated/contaminated/dirty/infected), age (categorized as $<$60, 60–69, $\geq$70 years old), sex, body-mass index ($\leq$29.9, $\geq$30 kg/m^2), American Society of Anesthesiologists (ASA) classification (half vs. three-fourths), designated preoperative laboratory values, and functional status (independent, partially dependent or totally dependent). Surgical risk factors incorporated were mode of anesthesia (general vs. spinal/epidural/regional), operative time, time from operation to discharge, and occurrence of a blood transfusion within 72 hours, postoperatively. Operative time was characterized as being greater or less than the average procedural time plus one standard deviation. Surgical outcomes included those specified within the NSQIP dataset by the surgical clinical reviewers and were indexed as mortality, all complications, major systemic, major local, minor systemic, and minor local complications.

Results

There were 57 patients who underwent TWA from 2005 to 2016. The mean age of the cohort was 62.3 ($\pm$13.8) years, with a predominance of women (57.7%) treated in the outpatient setting (67.3%). Most patients were functionally independent (98%) and ASA classification 1 or 2 (55.8%). A minority of patients had comorbid conditions to include smoking (17.3%), diabetes (15.4%), and on chronic steroid therapy (15.4%). The mean operative time was 139.5 minutes, however, the majority of cases (78.8%) were under this time (►**Table 1**). Evaluation of NSQIP data for outcomes measures to include major systemic, major local, minor systemic, and minor local complications did not find any complications in the immediate 30 day postoperative period (►**Table 1**). Between 2007 and 2016, there was an increased incidence of reported cases TWA in the NSQIP database (►**Table 2**).

Table 2 Yearly frequency of total wrist arthroplasty

Year of admission	
Year	Frequency
2005	0
2006	0
2007	1
2009	1
2010	2
2011	3
2012	5
2013	4
2014	12
2015	13
2016	11

Discussion

This analysis sought to correlate the short-term outcomes, complications, postoperative readmission rates for TWA with patient-specific factors. This analysis demonstrated that TWA may be safely and successfully performed without short-term complications among a varied patient population.

The present TWA cohorts averaged 62 years of age and were mostly (57%) females. These findings closely parallel the demographics of TWA reported in other large analyses to include American Board of Orthopaedic Surgeon candidate database and the National Inpatient Summary database.[4,23] In addition to the similar demographics between the large reported series of TWA, these cohorts also have similarly low compilation rates. The studied NSQIP database identified no postoperative complications in the acute 30-day setting even in patients with known preoperative comorbid factors (smoking,[24] chronic steroid use,[25] and diabetes[26]) that have been associated with an increased risk of wound complications. In a review of TWA performed during the ABOS (American Board of Orthopedic Surgery) part II case collection period, of the 0.7% of candidates which performed a TWA, the overall complication rate was 2% after 7-months follow-up. The complications included a nonspecific nerve palsy (1%). In a large American inpatient hospital dataset, another series experienced a higher complication rate (7%) for TWA. However, this report likely has higher complication rates as the sample is solely from inpatient records. Patients were older and more likely to have a medical comorbidity. Additionally, the complications were not defined, therefore it is hard to compare the rate found in this study with other studies.

In contrast, our patient population was younger, had a higher rate of outpatient surgery (67%), and likely represented a patient population less prone to short-term complication. Nonetheless, it is reasonable to counsel patients that TWA is a safe procedure, and one may reasonably anticipate a low risk of short-term complications.

The current analysis contains several limitations. First, the NSQIP lacks information concerning potential variables such as indication for surgery, implant used, and surgical technique.[22] The study attempted to account for the presence of comorbid disease by utilizing ASA classification as a proxy risk factor for overall health status.[14] Second, the database is unable to evaluate long-term outcomes which are important in the analysis of TWA to include loosening and implant survival. Third, the study was unable to evaluate functional outcomes postoperatively to include DASH, range of motion, and visual analog pain scores. Fourth, the study has limited power, which was not expected as the current study incorporated NSQIP data from nearly 700 hospitals over a 10-year period. However, in a review of the American Board of Orthopaedic Surgery

candidate cases, only 68 cases recorded over 10 years were reported. A review of the National Inpatient Sample had a slightly greater incidence with 199 cases over 10 years. The low incidence of reporting highlights the fact that TWA remains an uncommon procedure performed for varied diagnoses. In addition, the reduced power from the NSQIP analysis is not a finding limited to the present review alone.

Despite these limitations, the present analysis represents a reasonably sized cohort of patients undergoing TWA who were prospectively studied from nearly 700 institutions over a 12-year period. The current methodology offers valuable insight into the short-term complications following TWA as the NSQIP thoroughly collects a broad array of patient-based and surgical characteristics, as well as postoperative complications. Furthermore NSQIP data are consistent with other large-scale databases such as the American Board of Orthopedic Surgery candidate cases and the National Inpatient Summary in regards to incidence and patient outcomes. In conclusion, a patient undergoing a TWA may expect a reasonably low complication rate and the findings further support the safety of TWA as an outpatient procedure.

Note

This study was approved by our Institutional Review Board. All procedures followed as part of this study were in accordance with ethical standards of the Institutional Review Board and with the Helsinki Declaration of 1975, revised in 2000. This study was exempt from obtaining informed consent by the Institutional Review Board at our institution.

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None.

Conflict of Interest

Some authors are employees of the U.S. Federal Government and the U.S. Army. The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or reflecting the views of William Beaumont Army Medical Center, Walter Reed National Military Medical Center, the Department of Defense, or U.S. government.

The ACS NSQIP and the hospitals participating in the ACS NSQIP are the source of the data used herein; they are not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors.

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